

8(d) and in addition must comply with the design loads specified in Section 6.2 of the AAR Specifications for Tank Cars. The designs and calculations must provide for the loadings transferred to the outer jacket through the support system.

[Amdt. 179-32, 48 FR 27708, June 16, 1983, as amended by Amdt. 179-51, 61 FR 18934, Apr. 29, 1996; 65 FR 58632, Sept. 29, 2000]

§ 179.400-7 Tank heads.

(a) Tank heads of the inner tank and outer jacket must be flanged and dished, or ellipsoidal.

(b) Flanged and dished heads must have—

(1) A main inside dish radius not greater than the outside diameter of the straight flange;

(2) An inside knuckle radius of not less than 6 percent of the outside diameter of the straight flange; and

(3) An inside knuckle radius of at least three times the head thickness.

§ 179.400-8 Thickness of plates.

(a) The minimum wall thickness, after forming, of the inner shell and any 2:1 ellipsoidal head for the inner tank must be that specified in § 179.401-1, or that calculated by the following formula, whichever is greater:

$$t = Pd / 2SE$$

Where:

t = minimum thickness of plate, after forming, in inches;

P = minimum required bursting pressure in psig;

d = inside diameter, in inches;

S = minimum tensile strength of the plate material, as prescribed in AAR Specifications for Tank Cars, appendix M, table M1, in psi;

E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E = 1.0.

(b) The minimum wall thickness, after forming, of any 3:1 ellipsoidal head for the inner tank must be that specified in § 179.401-1, or that calculated by the following formula, whichever is greater:

$$t = 1.83 Pd / 2SE$$

Where:

t = minimum thickness of plate, after forming, in inches;

P = minimum required bursting pressure in psig;

d = inside diameter, in inches;

S = minimum tensile strength of the plate material, as prescribed in AAR Specifications for Tank Cars, Appendix M, Table M1, in psi;

E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E=1.0.

(c) The minimum wall thickness, after forming, of a flanged and dished head for the inner tank must be that specified in § 179.401-1, or that calculated by the following formula, whichever is greater:

$$t = [PL(3 + \sqrt{(L/r)})] / (8SE)$$

Where:

t = minimum thickness of plate, after forming, in inches;

P = minimum required bursting pressure in psig;

L = main inside radius of dished head, in inches;

r = inside knuckle radius, in inches;

S = minimum tensile strength of plate material, as prescribed in AAR Specifications for Tank Cars, appendix M, table M1, in psi;

E = 0.9, a factor representing the efficiency of welded joints, except that for seamless heads, E = 1.0.

(d) The minimum wall thickness, after forming, of the outer jacket shell may not be less than $\frac{7}{16}$ inch. The minimum wall thickness, after forming, of the outer jacket heads may not be less than $\frac{1}{2}$ inch and they must be made from steel specified in § 179.16(c). The annular space is to be evacuated, and the cylindrical portion of the outer jacket between heads, or between stiffening rings if used, must be designed to withstand an external pressure of 37.5 psig (critical collapsing pressure), as determined by the following formula:

$$P_c = [2.6E(t/D)^{2.5}] / [(L/D) - 0.45(t/D)^{0.5}]$$

Where:

P_c = Critical collapsing pressure (37.5 psig minimum) in psig;

E = modulus of elasticity of jacket material, in psi;

t = minimum thickness of jacket material, after forming, in inches;

D = outside diameter of jacket, in inches;

L = distance between stiffening ring centers in inches. (The heads may be considered as